THE EFFECT OF FLANGE THICKNESS ON THE BEHAVIOUR OF DIFFERENT TYPES OF FLANGED SHEAR WALL

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ABSTRACT

The main objective of this research work was to study and analyze the nonlinear behavior of different types of reinforced concrete flanged shear wall with different flange thickness using finite element method. The total volume of each model (I, U type) was similar, such that when thickness decreases in model, the length of wing increases. The nonlinear behavior of the different reinforced flanged shear walls is tested by nonlinear finite element program ANSYS. An attempt is made to evaluate the Stress distribution and displacement of flanged shear wall. Numerical results show that shear walls with thick flanges behave more efficient than walls with thin flanges.

KEYWORDS: Flanged Shear Wall, Finite Element Analysis, Nonlinear, Lateral Load

INTRODUCTION

In modern tall buildings, shear walls are commonly used as a vertical structural element for resisting the lateral loads that may be induced by the effect of wind and earthquakes. Shear walls generally used in varying cross sections i.e. rectangular shapes to more irregular cores such as channel, I, T, H, L, U, C, Z barbell shape, box etc.An introduction of flanged shear wall represents a structurally efficient solution to stiffen a building structural system because the main function of a flanged shear wall is to increase the rigidity for lateral load resistance.Shear walls in medium and high rise reinforced concrete buildings for the sake of interaction with the lateral forces, used by many of engineers, however past studies on the behavior and situation of shear wall indicated that shear walls with flange has better behavior. And this is due to interaction of flange and wall web. In shear wall the flanged is provided to increase the ductility, stiffness and resistance to bending of shear wall. The effect of flanged shear wall in control of displacement and simultaneous is similar to the performance in the tension and pressure declared advantages of flanged shear wall.

MODEL ANALYSIS

Two type of Flanged shear walls (such as I, U) are selected for investigating the influence of length and the thickness of flanged on the nonlinear behavior.

Theflanged shear wall is analyzed using the finite element software ANSYS 12.0.1.All the flanged shear walls had a web with thickness of 150mm and height of 2000mm.the flange dimensions of I and U shaped model described in table 1and 2. The model can be created by using command prompt line input or the Graphical User Interface (GUI). The solid element SOLID 65 in the ANSYS program was used in this analysis. It can be used for the three-dimensional modeling of solids with or without reinforcing bars. Eight nodes define the element, each having three translation degrees of freedom in X, Y and Z directions. Reinforcement can be defined in three different directions.In different types of flange shear wall, for the displacement of flanged of different shape shear wall figure and their size selected in such situation that surface of section in all of the walls is equal. With increasing of flanged length, width decreased. Because volume of usable concrete can be remain constant.The input parameters, characteristic strength of concrete considered was 25 N/mm^2 and

Poisson's ratio for concrete was 0.3. Ec is the modulus of elasticity of concrete was $Ec=2.5\times104$ N/mm^2, and density of concrete was $25\times10\text{-}6$ N/mm^{3}is used.

Table 1: Dimension of Web and Flange for I Shape Flanged Shear Wall

Kind of Shear Wall	Web Dimension (Mm)	I- Flange Dimension (Mm)	II-Flange Dimension (Mm)
I-1	3000×2000×150	2600×2000×180	2600×2000×180
I-2	3000×2000×150	2800×2000×170	2800×2000×170
I-3	3000×2000×150	3000×2000×160	3000×2000×160
I-4	3000×2000×150	3200×2000×150	3200×2000×150

Table 2: Dimension of Web and Flange for U Shaped Flanged Shear Wall

Kind of Shear Wall	Web Dimension (Mm)	I- Flanged Dimension(Mm)	II- Flanged Dimension(Mm)
U-1	3000×2000×150	2400×2000×180	2400×2000×180
U-2	3000×2000×150	2600×2000×170	2600×2000×170
U-3	3000×2000×150	2800×2000×160	2800×2000×160
U-4	3000×2000×150	3000×2000×150	3000×2000×150

The analysis has been carried out for the Flanged shear wall subjected to lateral loading. Lateral load applied through the slab which located on the top of shear wall. In addition 2400 KN of horizontal load were selected for better behavior of models. Figure 1 and figure 2 shows the reference model for I and U shaped flanged shear wall.
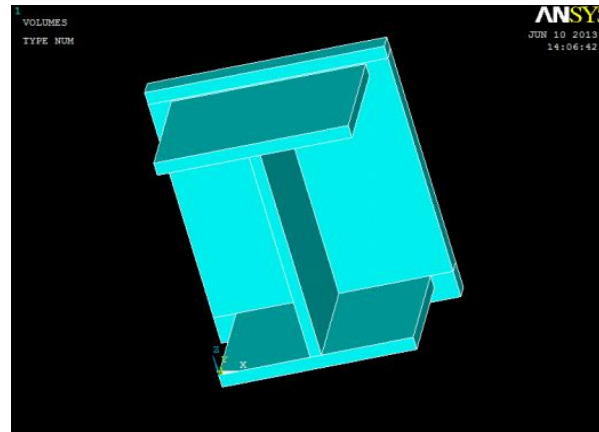

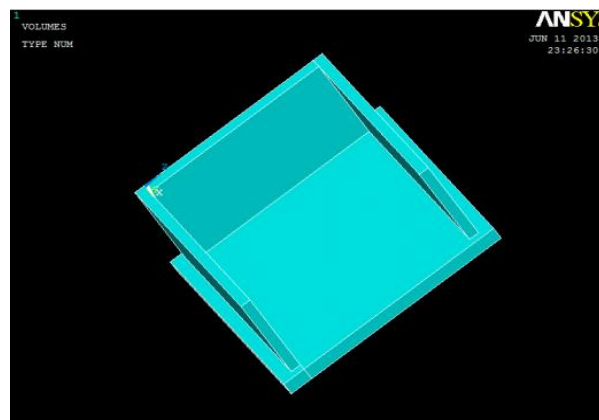**Figure 1: Model of I Shaped Flanged Shear Wall**

Figure 2: Model of U Flanged Shear Wall

RESULTS

The Finite element analysis was carried out for four type of I shaped and four type of U shaped flanged shear wall with varying thickness and length and constant volume by ANSYS 12.0.1. Result of analysis showed that flange shear wall with different Flanged dimensions had various response by lateral load. The load displacement curve shows the nonlinear behavior of Flanged shear wall.

When the lateral load of 1800 KN applied on the I-1 flanged shear wall which is having 180mm thick flange, shows the horizontal displacement of 2.503 mm. Similarly the lateral load applied on I-2, I-3, and I-4 flanged shear wall having 170,160,150mm flanged thickness respectively shows the displacement of 2.526 mm, 2.561mm, and 2.575 mm in horizontal direction. From stress distribution diagram, the value of stress in I-1, I-2, I-3, I-4 shear walls are 16.567, 16.68, 16.91, and 17.104 respectively (as shown in table 3).

Table 3: Results of Analysis of I Shape Flanged Shear Wall

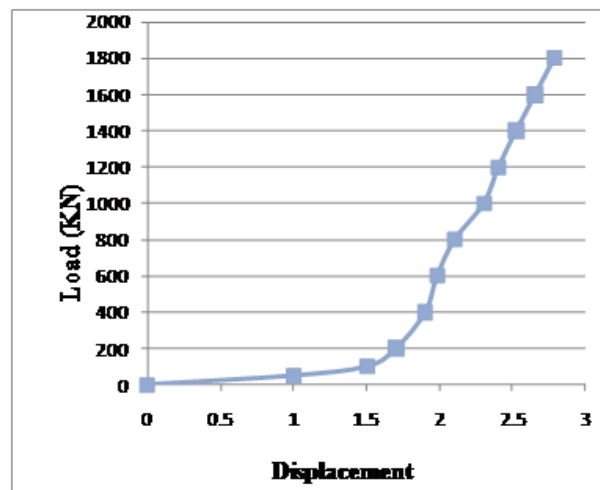| S. No.	Type of I Shaped Shear Wall	Load KN	Displacement mm	Von Mises Stresses N/mm^2
1	I-1	1800	2.503	16.567
2	I-2	1800	2.526	16.68
3	I-3	1800	2.560	16.91
4	I-4	1800	2.575	17.104

Figure 3: Load-Displacement Curve for I Shaped Flanged Shear Wall

When the lateral load of 1800 KN applied on the U-1 flanged shear wall which is having 180mm thick flange, shown the horizontal displacement of 5.735 mm. Similarly the lateral load applied on U-2, U-3, and U-4 flanged shear wall having 170,160,150mm flanged thickness respectively shows the displacement of 6.295 mm, 6.520, 6.625 mm in horizontal direction. From stress distribution diagram, the value of stress in walls U-1, U-2, U-3 and U-4 shear walls are 37.067, 41.198, 41.943, and 42.121 N/mm^2 respectively(as shown in table 4).

Table 4: Results of Analysis of U Shape Flanged Shear Wall

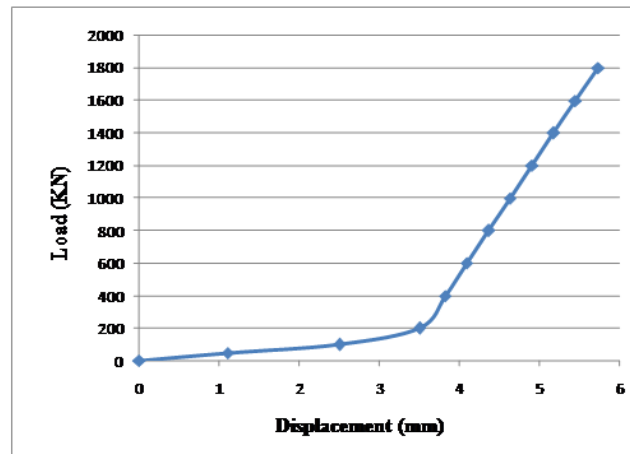| S. No.	Type of U Shaped Shear Wall	Load KN	Displacement mm	Von Mises Stresses N/mm^2
1	U-1	1800	5.735	37.067
2	U-2	1800	6.295	41.198
3	U-3	1800	6.520	41.948
4	U-4	1800	6.625	42.121

Figure 4: Load Displacement Curve for U Flanged Shear Wall

CONCLUSIONS

The comparison of models indicates that finite element model used in this study is capable of predicting the nonlinear behavior of the models when these are different thickness. Results of analysis in models and load- displacement of them indicated that thick flange had better behavior as compare to thin flanged shear wall for both types of Flanged shear wall.

ACKNOWLEDGEMENTS

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